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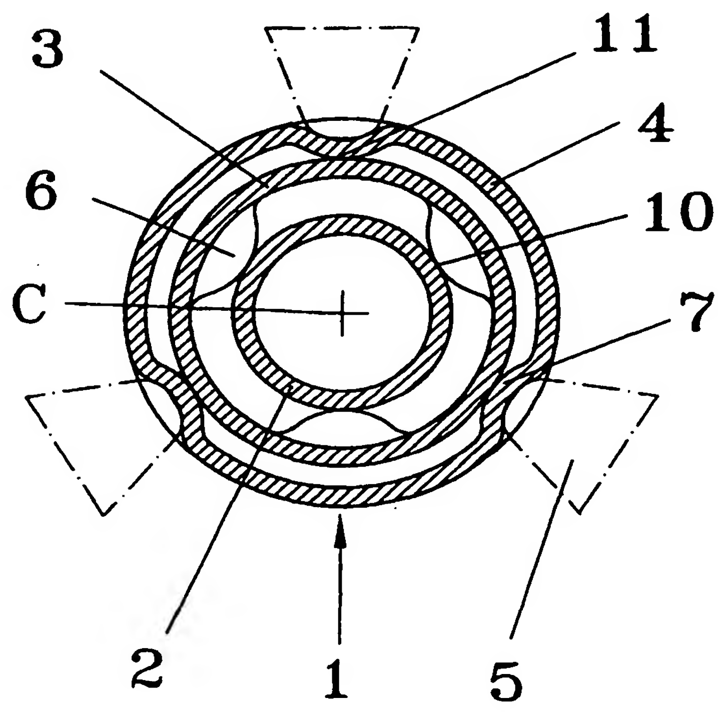

(57) Abstract: The invention relates to a lance (1) for introducing treatment substances into a melt. According to the invention, the lance (1) consists of a spacing means (3) being provided between an outer jacket pipe (4) and an inner inlet pipe (2). The spacing means has the shape of a generally tubular member making only point contact with the jacket pipe in outer contact points (11), and being connected thereto in at least some of the outer contact points (11). The invention also relates to a method for producing such a lance and a use thereof.

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

TITLE: LANCE

TECHNICAL FIELD

The present invention relates generally to lances used for treating molten metal baths.

BACKGROUND

For the treatment of metal melts in general, substances are introduced in the form of gas or powder or in fluid form. This may involve blowing oxygen gas from above down onto the melt in a converter, introducing alloying materials or introducing coal breeze. For these purposes, lances are used that may be generally named injection lances and that in their basic design consist of a hollow bar having an internal channel for introducing the substances. Due to the high temperatures, such lances are traditionally provided with a refractory coating that shall protect the hollow bar against the high temperatures. The coating consists of a ceramic material and serves excellently as a heat shield as long as it is intact. Basically, such a conventional lance is formed of a very thick hollow bar in order to minimize deflection of the lance, which may have a length of for instance about 4 meters. The fact is that large deflection of the lance exposes the ceramic material to very great stress, leading to cracks and fracture of the material.

However, a severe problem arises due to the fact that the large mass of the thick hollow bar results in a large thermal expansion. The ceramic material and the hollow bar have very different coefficients of thermal expansion, which means that there is a very large risk of stress and tension appearing therebetween and thus, once more a very large risk of cracking of the ceramic material. As soon as cracks, which may even be microscopic, occur in the ceramic material, molten metal and/or slag may penetrate into the lance and quickly destroy it.

For the purpose of increasing the useful life of such injection lances, many solutions have been presented that aim at reducing the above mentioned problems. An example of such a solution appears from the document DE 36 16510 A1, describing a so called double jacket lance formed by an inner blow pipe and an outer jacket pipe supporting the refractory material. Between the outer and inner pipes is formed a generally ring-shaped chamber through which a cooling medium circulates for the purpose of cooling the inner and outer

pipes so that no stress arises in them. Furthermore, longitudinal partitions are used for dividing the chamber into different cooling channels practically all over the entire length of the lance. These partitions also serve to connect the inner and outer pipes and to strengthen or stiffen the structure for the purpose of preventing the above described deflection of the lance. However, a problem with this prior art lance is that the large contact surfaces between the outer and inner pipes, which are formed by the continuous partitions, result in a large heat transfer to the inner pipe. According to said document, this large heat transfer is actually intentional and serves the purpose of distributing the heat over the surfaces making contact with the cooling medium. The problem is that the lance requires internal cooling and may hardly be used without a supply of cooling medium, since the problems of thermal expansion would in such a case rather be aggravated by the large heat transfer.

SUMMARY OF THE INVENTION

The invention eliminates the above discussed problems in an efficient and appropriate way.

A general object of the invention is to provide a solution to the problem of the comparatively short useful life of lances that at their outer jacket are provided with a layer of refractory material serving as a heat shield.

Consequently, a basic object of the invention is to find a simple and appropriate way of providing a lance that on the one hand has sufficient flexural rigidity not to cause any harmful deflection during normal operation, and that on the other hand minimizes the problems of different thermal expansion of the constituent materials of the lance.

The invention is based on the knowledge that the risk of cracking of the refractory material may be eliminated by simultaneously optimizing the flexural rigidity of the lance and minimizing the difference in thermal expansion between the different parts of the lance. According to the invention, this is accomplished by arranging a spacing means between an outer jacket pipe and an inner inlet pipe. The spacing means is in the form of at least one generally tubular member making only point contact with the jacket pipe and being firmly connected thereto in at least some of the contact points. Thereby, is achieved on the one hand a good flexural rigidity of the lance, while the inlet pipe may simultaneously be made

relatively thin, i.e. having a small heat absorbing mass, and on the other hand a limited heat transfer through distributed contact points.

According to an embodiment of the invention the lance comprises two or more spacing members between jacket pipe and inlet pipe and the spacing members make mutual point contact with each other, whereby stiffening or strengthening may be increased and heat transfer may be reduced.

According to another embodiment of the invention, the spacing members or an inner spacing member also make/makes point contact with the inner inlet pipe, whereby heat transfer is further reduced.

According to another embodiment of the invention, the spacing member is firmly connected also to the inner inlet pipe, at least in some of the contact points.

According to a further embodiment of the invention, the spacing member is moreover connected to the jacket pipe and possibly also to the inlet pipe by spot welds in the contact points.

According to other embodiments of the invention the outer contact points are arranged in groups along the length of the lance; the contact points of the groups are arranged uniformly distributed around the circumference; and/or the outer contact points of the respective groups are provided in different numbers or displaced relative to each other around the circumference. All of these embodiments contribute to accomplishing an advantageous distribution of the heat transfer as well as a uniform strengthening or stiffening of the lance.

According to further embodiments of the invention also the inner contact points are arranged in groups along the length of the lance; these inner contact points of the groups are arranged to be uniformly distributed around the circumference; and/or the inner contact points of the respective groups are likewise provided in different numbers or displaced relative each other around the circumference. All of these embodiments contribute further to accomplishing the advantageous distribution of the heat transfer as well as the uniform stiffening of the lance.

According to yet another embodiment of the invention the outer and the inner contact points, respectively, consist of depressed areas or indentations in the jacket pipe and the spacing member, respectively.

Further embodiments of this first aspect of the invention are stated in the corresponding dependent claims.

Another object of the invention is to provide an appropriate method of producing a lance according to the invention.

Thus, according to another aspect of the invention, it is suggested that an inlet pipe is inserted into a tubular spacing member, which is then deformed in points into contact with the inlet pipe, that the spacing member with inserted inlet pipe is then inserted into an outer jacket pipe or alternatively into a further spacing member and then into a jacket pipe that is in turn brought into point contact with the spacing member or the outer spacing member. Thereby, the jacket pipe and the spacing member or the outer spacing member are connected by spot welding in the deformed areas. Likewise, the spacing members are mutually connected by spot welding in the deformed areas

Embodiments of this aspect of the invention are clear from the corresponding dependent claims.

According to yet another aspect of the invention, it is suggested that a lance according to the invention is used as an oxygen injection lance by steelmaking.

These and other objects of the invention are achieved by means of the invention as defined in the accompanying patent claims.

Briefly, the present invention offers the following advantages:

- A long useful life due to a substantially reduced risk of cracking in a surrounding refractory material;

- Elongation through heating may in principle be avoided;
- A structure with flexural strength may be achieved with a comparatively very thin inlet pipe, i.e. having a small heat absorbing mass;
- Small heat transfer to the spacing member and the inlet pipe, respectively, due to the point contact;
- A possibility to conduct cooling medium or other media in inner and outer channels;
- Cooling medium that is conducted in the channels may be given an advantageous course of flow by mutual displacement of the contact points in the different groups.

Further objects, features and advantages of the invention, as well as further embodiments thereof are evident from the dependent claims and the following description of exemplifying embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention is described in more detail in connection with the appended drawings, in which:

Fig. 1 is a partial perspective view, partly in section, of a first embodiment of a lance according to the invention,

Fig. 2 is another partial perspective view of the lance according to fig. 1, cut open to more clearly illustrate the outer jacket and the spacing pipe of the lance,

Fig. 3 is a sectional view through the inlet pipe and the spacing pipe of the lance according to fig. 1,

Fig. 4 is a sectional view through the lance according to fig. 1,

Fig. 5 is a partial perspective view, partly in section, of a second embodiment of a lance according to the invention,

Fig. 6 is a sectional view through the inlet pipe and the spacing pipe in the lance according to fig. 5,

Fig. 7 is a sectional view through the lance according to fig. 5,

Fig. 8 is a sectional view through an inlet pipe and a spacing pipe in a further embodiment of the invention,

Fig. 9 is a sectional view through a lance corresponding to the embodiment illustrated in fig. 8, and

Fig. 10 is a sectional view through a lance according to yet another embodiment of the invention.

DETAILED DESCRIPTION

With reference primarily to figs. 1-4, the basic principles of the invention shall now be described by means of a first embodiment and at the same time the differences in comparison with prior art designs shall be explained. In this context it shall be explained that throughout this application the expression "point contact" is used to indicate a contact that is restricted both with regard to the circumference and to the longitudinal extension of the constituent parts of the lance. Consequently, this expression does not indicate any exact size of the point in which the contact takes place.

Figs. 1 and 2 illustrate a short portion of a lance 1 according to the invention, which in practice typically has a length of about 4 meters. Furthermore, in the figures the lance 1 is partly cut up in two different ways in order to illustrate the constituent elements and parts thereof. As is most clearly evident from fig. 1, the lance 1 is built up of an inner inlet pipe 2 that is employed to introduce treatment substances in a melt (i.e. a molten bath), not illustrated, for instance in a converter. The inlet pipe 2 is inserted into a spacing member 3 that is likewise generally tubular. Accordingly, the spacing member substantially concentrically surrounds the inlet pipe 2. The spacing member 3 is in turn surrounded by an outer jacket 4 that at is outer surface supports a heat shield in the form of a layer of cast

refractory material 8, preferably ceramic material, of which only a short portion is illustrated in fig. 1.

From figure 2 and in particular from figures 3 and 4 it is clear that in the illustrated embodiment the spacing member 3 is formed by a pipe having an inner diameter being essentially larger than the outer diameter of the inlet pipe 2. Contact between the inlet pipe 2 and the spacing member 3 is established by forming indented or depressed areas 6 in the circumferential surface of the spacing member 3. These indented or depressed areas 6 form inner contact points 10, i.e. there is essentially point contact present between the inlet pipe 2 and the spacing member 3. Normally, no connection is required between the inlet pipe 2 and the spacing member 3, since the depressed areas form an interference fit with the inlet pipe 2. However, the inlet pipe 2 may also be connected to the spacing member 3 in some or all of the contact points 10, preferably by spot welds, as will be described further below.

Correspondingly, fig. 1 and particularly fig. 4 show that in the illustrated embodiment the jacket pipe 4 is formed by a pipe having an inner diameter that is essentially larger than the outer diameter of the spacing member 3. Contact between the jacket pipe 4 and the spacing member 3 is likewise established through indented areas 7 that are formed in the circumferential surface of the jacket pipe 4. These indented areas 7 form outer contact points 11, i.e. there is essentially point contact present also between the jacket pipe 4 and the spacing member 3. The jacket pipe 4 is firmly connected to the spacing member 3, primarily for the purpose of preventing too substantial elongation of the jacket pipe in relation to the refractory heat shield 8. This connection preferably consists of spot welds applied in at least some of the outer contact points 11. Depending upon the field of application spot welds are in some cases applied to all outer contact points 11.

This design, with only point contact between the different parts of the lance 1, contributes to reducing the heat transfer between the parts of the lance, and at the same time the lance still has sufficient flexural rigidity. These properties are further improved by the distribution of the contact points 10, 11. Thus, the outer as well as the inner contact points 10 and 11, respectively, i.e. the corresponding indented or depressed areas 6 and 7, respectively, are each arranged in groups separated from each other along the length of the lance 1. Each such group

consists of a number of, in the illustrated example three, contact points 10 and 11, respectively, arranged to be uniformly distributed around the circumference of the spacing member 3 and the jacket pipe 4, respectively. In the illustrated example the groups of inner contact points 10 are axially, with regard to the center axis C of the lance 1, separated from the groups of outer contact points 11.

For the purpose of further spreading the distribution of the contact points 10, 11 and thereby improving their strengthening effect on the lance 1 as well as their favorable effect on the heat transfer, the inner contact points 10 and the outer contact points 11 are also in their groups rotated half a pitch in relation to each other. In other words, seen axially as in figure 4, all inner contact points 10 are displaced in the circumferential direction in relation to the outer contact points 11, and at the same time all groups of contact points 10, 11 are separated along the length of the lance 1. In addition to being illustrated in figures 3 and 4, this arrangement is also illustrated in fig. 1, where the depressed areas that are visible in the illustrated view have been given reference numbers 6 and 7, respectively, and have been drawn with normal blackness, whereas the depressed areas that are hidden in the illustrated view have been given reference numbers 6D and 7D, respectively, and are drawn with pale lines.

With the described design, the different constituent pipes 2, 3, 4 of the lance 1 may be relatively thin-walled without reducing the flexural rigidity of the lance 1. This, as well as the pure point contact provided between the pipes results in a much reduced heat transfer when compared to conventional designs. All in all, this results in a substantial reduction of the stress on the refractory heat shield 8 that is otherwise caused by thermal expansion of the parts of the lance 1 that are positioned inside the shield 8. The difference in diameter, disregarding the depressed areas 6 and 7, respectively, between the spacing pipe 3 and the jacket pipe 4, on the one hand, and between the spacing pipe 3 and the inlet pipe 2, on the other hand, and the fact that the different parts are firmly connected to each other in the contact points 10, 11, for instance by spot welds, likewise contributes to the latter result. Hereby, expansion or other deformation of the spacing pipe 3 can take up excessive thermal expansion, the latter thereby taking up stress caused by temperature differences between parts of the lance 1.

Inside the layer 8 of refractory material, on the outer jacket 4, is provided appropriate reinforcement, not illustrated in the drawings, for reinforcing the layer of refractory material. Thereby, it has proven particularly advantageous to wind expanded metal, i.e. a net-shaped or grate-shaped material, around the jacket pipe 4. With such a design the refractory material will penetrate down through the expanded metal and into the depressed areas 7, and will thereby be connected to the jacket pipe in a very appropriate manner.

A presently preferred method of producing the described lance according to the invention shall now be described. In a first step, an inlet pipe 2 is inserted into a spacing member 3. Then, the spacing member 3 is inserted into a chuck that in fig. 3 is only illustrated by its indicated jaws 5, three in number. With the spacing member 3 inserted into position with the jaws 5 placed at the positions of the first group of inner contact points 10, the chuck is activated to form the depressed areas 6. Thereby, all of these areas 6 of the group are formed with such a depth that they, i.e. the spacing member 3, engage the inlet pipe 2. The used chuck does in itself not constitute any part of the invention and is not illustrated and described further herein. However, it is apparent to a man skilled in the art that each suitable chuck or corresponding tool may be used that in this manner is capable of applying uniform pressure to a number of points at the circumference of a tubular workpiece. When this first group has been formed, the spacing member 3 is inserted in steps into the chuck, with activation thereof after each displacement, for forming the rest of the groups of depressed areas 6.

In cases where this is required, the spacing member 3 is then connected to the inlet pipe 2 in some or all of the contact points 10, preferably by spot welding. The unit formed by the spacing member 3 and the inlet pipe 2 is then inserted into a jacket pipe 4. Then, the jacket pipe is inserted into the chuck in a corresponding manner, up to the position of the first group of outer contact points 11. By activating the chuck, outer depressed areas 7 are formed down into contact with the spacing pipe 3. In the illustrated embodiment, the difference in diameter between the jacket pipe and the spacing member is less than that between the spacing member and the inlet pipe, whereby in this case the outer depressed areas 7 will be both shallower and smaller. Like before, all of the outer depressed areas 7 are then formed by alternating stepwise insertion of the jacket pipe into the chuck and activation of the latter. When forming these outer areas 7, the jacket pipe 4 is rotated and inserted into the chuck so that the groups of

outer depressed areas 7 or contact points 11 are positioned between the groups of inner depressed areas 6 and displaced around the center axis C of the lance in relation thereto. Finally, the spacing member 3 is then connected to the jacket pipe 4, preferably in all contact points 11, likewise by spot welding.

A layer of refractory material 8, preferably a ceramic material, is then cast onto the outer surface of the jacket pipe 4 in a separate working stage. This is done in a basically conventional way, but preferably with the fitting of the above mentioned reinforcement or armouring, for instance in the form of expanded metal.

Figs. 5-7 illustrate a second embodiment of a lance 100 according to the invention. In its general design, this lance 100 corresponds completely to the lance 1 according to the first embodiment and differs therefrom only by the positioning of the groups of inner and outer depressed areas 6 and 7, respectively. More specifically, the inner contact points 10 of successive groups are displaced in relation to each other around the circumference of the lance 100 and the outer contact points of successive groups are likewise displaced in relation to each other around the circumference of the lance 100. In the illustrated example the outer and inner depressed areas 6 and 7, respectively, of successive groups are displaced by a half pitch in relation to each other around the circumference of the lance 100, which is most clearly visible in the sectional views of figs. 6 and 7, but also in fig. 5. Like before, the inner and outer areas of the respective first groups have thereby been denoted by 6 and 7, respectively, while the inner and outer areas of the respective second groups have been denoted by 6' and 7', respectively. Like in the first embodiment, hidden areas have in fig. 5 been denoted by the addition of D. Notwithstanding the illustrated degree of mutual displacement, the invention also comprises designs where adjacent groups are alternatively displaced in larger or smaller steps than by half a pitch. The same applies to the mutual displacement between the groups of outer and inner depressed areas, which in the first embodiment has been shown to be substantially half a pitch.

This second embodiment of the lance 100 is likewise produced basically in the same way as the first embodiment according to figs. 1-4. The difference is that when the groups of depressed areas 6, 7 are being formed, the spacing pipe 103 and the jacket pipe 104, respectively, are

here rotated in one and the same or alternating directions in the chuck, in the example by half a pitch between the depressed areas of the group, after the forming of each group.

In figs. 8 and 9 is illustrated a further embodiment of a lance 200 according to the invention. Like before, this lance consists of an inlet pipe 2 that is inserted into a spacing member 203. The spacing member 203 is also here formed with depressed areas 206 forming inner contact points 210 with the inlet pipe and possibly being connected thereto. The depressed areas 206 are formed in a corresponding chuck having jaws 5, but in this case the spacing member 203 is allowed to bulge outwardly between the depressed areas 206, forming bulging or convex areas 207. Such bulging of the areas between the jaws 5 occurs automatically if these areas are not restrained during activation of the chuck.

Consequently, the bulging areas 207 protrude past the original circumference of the spacing member 203. When this unit, which is formed by the inlet pipe and the spacing member, is inserted into the jacket pipe 204, these bulging areas 207 form the outer contact points 211 with the jacket pipe, without requiring any deformation thereof. Consequently, the jacket pipe 204 may be directly connected to the spacing member 203, preferably likewise by spot welding. However, to facilitate insertion of the unit 2, 203 into the jacket pipe 204, the jacket pipe 204 is suitably selected having an inner diameter that basically corresponds to, but is slightly larger than an imaginary circumferential line being tangential to the bulging areas 207 of the spacing member. Such a clearance is normally taken up by the spot welding, but otherwise a slight depression may be performed, for instance by means of the jaws, in order to establish the outer contact points 211. In this embodiment, the groups of depressed and bulging areas, respectively, may be formed and distributed in the manners described above, as well as with the modifications and variations described below.

Finally, in fig. 10 is illustrated an embodiment of the invention that starts from the embodiment according to figs. 8 and 9 but that may likewise be applied to the designs according to figs. 1-7. Thus, the lance 300 according to this design consists of an inlet pipe 2 that is inserted into an inner spacing member 303A. Like in the embodiment according to figs. 8 and 9, this inner spacing member 303A is formed with depressed and bulging areas 306A, 307A, respectively, the former thereby forming inner contact points 319 with the inlet pipe 2 and

possibly being connected thereto. However, in this case the formed unit 2, 303A is not inserted into a jacket pipe but into an outer spacing member 303B having a larger diameter.

The outer spacing member 303B is likewise formed with depressed and bulging areas 306B and 307B, respectively, the former thereby forming intermediate contact points 315 with the bulging areas 307A of the inner spacing member 303A, and possibly being connected thereto by spot welding. Finally, the unit formed by the inlet pipe 2 and the inner and outer spacing members 303A, 303B is inserted into a jacket pipe 304, which is dimensioned in relation to the outer spacing member 303B in accordance with the principle described in connection to fig. 8 and 9. Thereby, the bulging areas 307B of the outer spacing member 303B form outer contact points 311 with the jacket pipe 304 and are connected thereto in these points. Even though fig. 10 describes the use of two spacing members 303A and 303B, it shall be apparent that the invention also comprises building up the lance 300 using any other number of spacing members that is suitable for a specific application.

In addition to the above described variations of differently positioned groups of depressed and bulging areas, respectively, the invention also comprises the possibility of arranging different numbers of depressed and bulging areas, respectively, in the different groups, both in groups having the same and different types of contact points. These variations may possibly also be combined with the displacement around the circumference. The number of depressed areas in each group may preferably be between 1-6, whereby, in the case with one area per group, the areas may be arranged in a helical shape around the circumference. However, in most cases a number of 3-4 areas per group are suitable, and where spot welding is employed, it has turned out that the best result is obtained with 4 areas per group.

It will be understood by those skilled in the art that various modifications and changes may be made to the present invention without departure from the scope thereof, which is defined by the appended claims.

CLAIMS

1. A lance (1; 100; 200; 300) for introducing treatment gases or treatment substances into a metallurgical melt, consisting of an inner inlet pipe (2), an outer jacket pipe (4; 104; 204; 304) supporting a layer (8) of refractory material on its outer surface, and spacing means (3; 103; 203; 303A, 303B) between the inner and outer pipes, **characterized by** at least one spacing member (3; 103; 203; 303A, 303B) having a generally tubular shape, in that the spacing member (3; 103; 203) or alternatively an outer spacing member (303B) at its outer circumference is in point contact with the jacket pipe (4; 104; 204; 304) at a number of outer contact points (11; 211; 311) that are separated around the circumference as well as along the length thereof and in that the spacing member is firmly connected to the jacket pipe in at least some of these contact points.

2. A lance (300) according to claim 1, **characterized by** two or more spacing members (303A, 303B) being arranged substantially concentrically between the jacket pipe (304) and the inlet pipe (2), the spacing members being in mutual point contact with each other at intermediate contact points (315).

3. A lance (1; 100; 200; 300) according to claim 1 or 2, **characterized in** that the spacing member (3; 103; 203) or alternatively an inner spacing member (303A) at its inner circumference is in point contact with the inlet pipe (2) at a number of inner contact points (10; 210; 310), separated around the circumference as well as along the length.

4. A lance (1; 100; 200; 300) according to claim 3, **characterized in** that the spacing member (3; 103; 203), alternatively the inner spacing member (303A), is connected to the inlet pipe (2) in at least some of said inner contact points (10; 210; 310).

5. A lance (1; 100; 200; 300) according to any of claims 1-4, **characterized in** that the spacing member (3; 103; 203) or alternatively the outer (303B) and the inner (303A) spacing member, respectively, at the outer contact points (11; 211; 311) and, where appropriate, also at the inner contact points (10; 210; 310), respectively, is connected to the jacket pipe (4; 104; 204; 304) and the inlet pipe (2), respectively, by spot welds.

6. A lance (300) according to any of claims 2-5, **characterized in** that at the intermediate contact points (315) the spacing members (303A, 303B) are connected to each other by spot welds.

7. A lance (1; 100; 200; 300) according to any of claims 1-6, **characterized in** that the outer contact points (11; 211; 311) are arranged in groups and in that the groups are separated along the length of the lance (1; 100; 200; 300).

8. A lance (1; 100; 200; 300) according to claim 7, **characterized in** that the outer contact points (11; 211; 311) of each group are arranged uniformly distributed around the circumference of the spacing member (3; 103; 203; 303B).

9. A lance (1; 100; 200; 300) according to claim 7 or 8, **characterized in** that each group contains 1-6, preferably 3-4, outer contact points (11; 211; 311).

10. A lance (1; 100; 200; 300) according to any of claims 7-9, **characterized in** that the outer contact points (11; 211; 311) of successive groups along the length of the lance are provided in a mutually different number.

11. A lance (100) according to any of claims 7-10, **characterized in** that the outer contact points (11) of successive groups are displaced in relation to each other around the circumference of the lance (100).

12. A lance (1; 100; 200; 300) according to any of claims 3-11, **characterized in** that the inner contact points (10; 210; 310) and, where appropriate, the intermediate contact points (315) are arranged in groups and in that the groups are separated along the length of the lance (1; 100; 200; 300).

13. A lance (1; 100; 200; 300) according to claim 12, **characterized in** that the inner contact points (10; 210; 310) and, where appropriate, the intermediate contact points (315) of each group are arranged uniformly distributed around the circumference of the spacing member/members (3; 103; 203; 303A, 303B).

14. A lance (1; 100; 200; 300) according to claim 12 or 13, **characterized in** that each group contains 1-6, preferably 3-4, inner contact points (10; 210; 310) and, where appropriate, intermediate contact points (315).

15. A lance (100) according to any of claims 12-14, **characterized in** that the inner contact points (10) of successive groups along the length of the lance (100) are provided in a mutually different number and/or alternatively displaced around the circumference of the spacing member (103) in relation to each other.

16. A lance (100) according to claim 11 or 15, **characterized in** that the inner (10) and the outer (11) contact points, respectively, of successive groups are displaced with a half pitch in relation to each other around the circumference of the lance (100).

17. A lance (1; 100; 200; 300) according to any of claims 3-16, **characterized in** that the outer and inner contact points (11; 211; 311 and 10; 210; 310, respectively) and, where appropriate, the intermediate contact points (315) are provided displaced in relation to each other around the circumference of the lance.

18. A lance (1; 100; 200; 300) according to any of claims 1-17, **characterized in** that the outer and, where appropriate, the inner contact points (11 and 10, respectively) are formed by depressed areas (7, 7' and 6, 6', respectively) in the jacket pipe (4; 104) and the spacing member (3; 103), respectively.

19. A lance (200; 300) according to any of claims 1-17, **characterized in** that the outer contact points (211; 311) are formed by bulging areas (207; 307B) in the spacing member (203) and the outer spacing member (303B), respectively, in that the inner contact points (210; 310) are formed by depressed areas (206 and 306A, respectively) in the spacing member (203) and the inner spacing member (303A), respectively, and in that, where appropriate, the intermediate contact points (315) are formed by depressed areas (306B) in the outer spacing member (303B) and bulging areas (307A) in the inner spacing member (303A).

20. A lance (1; 100) according to any of claims 1-19, **characterized in** that at its outer surface the jacket pipe (4; 104) is provided with a layer of expanded metal, onto which is applied a layer (8) of ceramic material.

21. A method of producing a lance (1; 100) for introducing treatment gases or treatment substances into a metallurgical melt, and consisting of an inner inlet pipe (2), an outer jacket pipe (4; 104) and spacing means (3; 103) between the inner and outer pipes, **characterized in** that the inlet pipe (2) is inserted into a spacing member (3; 103) in the form of a tube having significantly larger inner diameter than the outer diameter of the inlet pipe, in that along its length the spacing member (3; 103) is deformed for forming depressed areas (6, 6') having such a depth that they come into contact (inner contact points 10) with the inlet pipe, in that the unit formed by the inlet pipe (2) and the spacing member (3; 103) is inserted into a jacket pipe (4; 104) having significantly larger inner diameter than the outer diameter of the spacing member, in that along its length the jacket pipe (4; 104) is deformed for forming depressed areas (7, 7') having such a depth that they come into contact (outer contact points 11) with the spacing member and in that the jacket pipe and the spacing member are connected to each other by spot welding in at least some of the depressed areas (7, 7') of the jacket pipe.

22. A method of producing a lance (200) for introducing treatment gases or treatment substances into a metallurgical melt, and consisting of an inner inlet pipe (2), an outer jacket pipe (204) and spacing means (203) between the inner and outer pipes, **characterized in** that the inlet pipe (2) is inserted into a spacing member (203) in the form of a tube having significantly larger inner diameter than the outer diameter of the inlet pipe, in that along its length the spacing member (203) is deformed for forming depressed areas (206), having such a depth that they come into contact (inner contact points 210) with the inlet pipe, and bulging areas (207), in that the unit formed by the inlet pipe (2) and the spacing member (203) is inserted into a jacket pipe (204) having an inner diameter substantially corresponding to an imaginary circumferential line being tangential to the bulging areas (207) of the spacing member, whereby the jacket pipe (204) and the bulging areas (207) form outer contact points (211), and in that the jacket pipe and the spacing member are connected to each other by spot welding in at least some of the outer contact points (211).

23. A method of producing a lance (300) for introducing treatment gases or treatment substances into a metallurgic melt, and consisting of an inner inlet pipe (2), an outer jacket pipe (204) and spacing means (303A; 303B) between the inner and outer pipes, **characterized in** that the inlet pipe (2) is inserted into an inner spacing member (303A) in the form of a tube having significantly larger inner diameter than the outer diameter of the inlet pipe, in that along its length the inner spacing member (303A) is deformed for forming depressed areas (306A), having such a depth that they come into contact (inner contact points 310) with the inlet pipe, and bulging areas (307A), in that the unit formed by the inlet pipe (2) and the inner spacing member (303A) is inserted into an outer spacing member (303B), in that along its length the outer spacing member (303B) is deformed for forming depressed areas (306B), having such a depth that they come into contact (intermediate contact points 315) with the inner spacing member (303A), and bulging areas (307B), in that the unit formed by the inlet pipe (2) and the inner and outer spacing members (303A, 303B) is inserted into a jacket pipe (204) having an inner diameter that substantially corresponds to an imaginary circumferential line being tangential to the bulging areas (307B) of the outer spacing member (303B), whereby the jacket pipe (204) and the bulging areas (307B) form outer contact points (311), and in that the jacket pipe and the outer spacing member are connected to each other by spot welding in at least some of the outer contact points (311).

24. A method according to claim 21, 22 or 23, **characterized in** that prior to inserting the unit formed by inlet pipe (2) and spacing member/members (3; 103; 203; 303A, 303B) into the jacket pipe (4; 104; 204), the spacing member (3; 103; 203) or the inner spacing member (303A), respectively, and the inlet pipe (4; 104; 204) are connected to each other by spot welding in at least some of the depressed areas (6; 6'; 206 and 306A, respectively) of the spacing member and the inner spacing member, respectively, and, where appropriate, the inner and outer spacing members (303A and 303B, respectively) are connected to each other by spot welding in at least some of the intermediate contact points (315).

25. A method according to any of claims 21-24, **characterized in** that the depressed areas (6; 6', 206; 306A, 306B) and, where appropriate, the bulging areas (207; 307A, 307B) of the spacing member/members (3; 103; 203; 303A, 303B) are formed by inserting the unit formed by the inlet pipe (2) and the spacing member/members (3; 103; 203; 303A, 303B) into a chuck

(jaws 5), whereby activation of the chuck forms a group of depressed areas and, where appropriate, bulging areas (207; 307A, 307B), distributed around the circumference of the spacing member (3; 103; 203; 303A, 303B) and in a number corresponding to the jaws of the chuck.

26. A method according to claim 25, **characterized in** that after forming a group of depressed areas (6; 6', 206; 306A, 306B) and, where appropriate, bulging areas (207; 307A, 307B), the unit (2, 3; 2, 103; 2, 203; 2, 303A, 303B) is moved stepwise through the chuck (jaws 5) and the chuck is activated after each stepwise movement, for forming separated groups along the length of the unit.

27. A method according to claim 26, **characterized in** that between each stepwise movement the unit (2, 103) is rotated around its own axis (C) for mutual displacement of the different groups around the circumference of the unit.

28. A method according to claim 27, **characterized in** that after each stepwise movement the unit (2, 103) is rotated in one and the same or alternatively in alternating directions around its own axis (C).

29. A method according to any of claims 21 and 24-28, **characterized in** that subsequent to the insertion of the unit formed by the inlet pipe (2) and the spacing member (3; 103) into the jacket pipe (4; 104), the depressed areas (7; 7') of the jacket pipe are formed by inserting the lance (1; 100), formed by the inlet pipe (2), the spacing member (3; 103) and the jacket pipe, into a chuck (jaws 5), whereby activation of the chuck forms a group of depressed areas (7; 7') distributed around the circumference of the jacket pipe and in a number corresponding to the jaws of the chuck.

30. A method according to claim 29, **characterized in** that after forming a group of depressed areas (7; 7') in the jacket pipe (4; 104), the lance (1; 100) is moved stepwise through the chuck (jaws 5) and the chuck is activated after each stepwise movement for forming separated groups along the length of the unit.

31. A method according to any of claims 21 and 24-30, **characterized in** that the groups of depressed areas (7; 7') in the jacket pipe (4; 104) are formed displaced along the length of the lance (1; 100) in relation to the groups of depressed areas (6; 6') formed in the spacing member (3; 103).

32. A method according to any of claims 29-31, **characterized in** that between each stepwise movement the lance (100) is rotated around its own axis (C) for mutual displacement of the different groups around the circumference of the lance.

33. A method according to claim 32, **characterized in** that after each stepwise movement the lance (100) is rotated in one and the same or alternatively in alternating directions around its own axis (C).

34. A method according to any of claims 21 and 24-33, **characterized in** that after forming the depressed areas (7; 7') in the jacket pipe (4; 104) expanded metal is wound onto the outer surface of the jacket pipe, whereupon a layer of ceramic material (8) is cast thereon.

35. The use of a lance (1; 100; 200; 300) according to any of claims 1-20 as an oxygen injection lance by steelmaking.

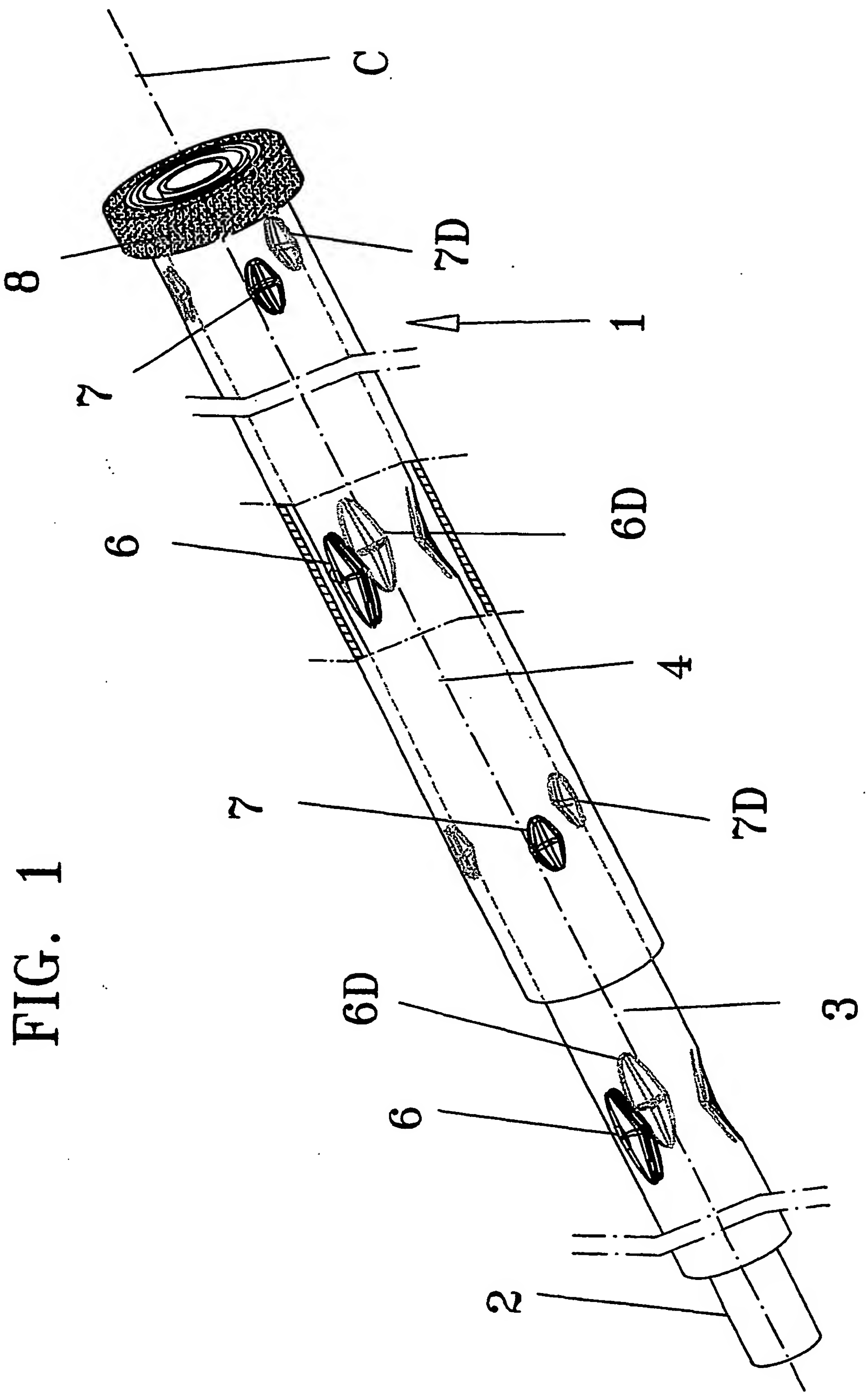


FIG. 1

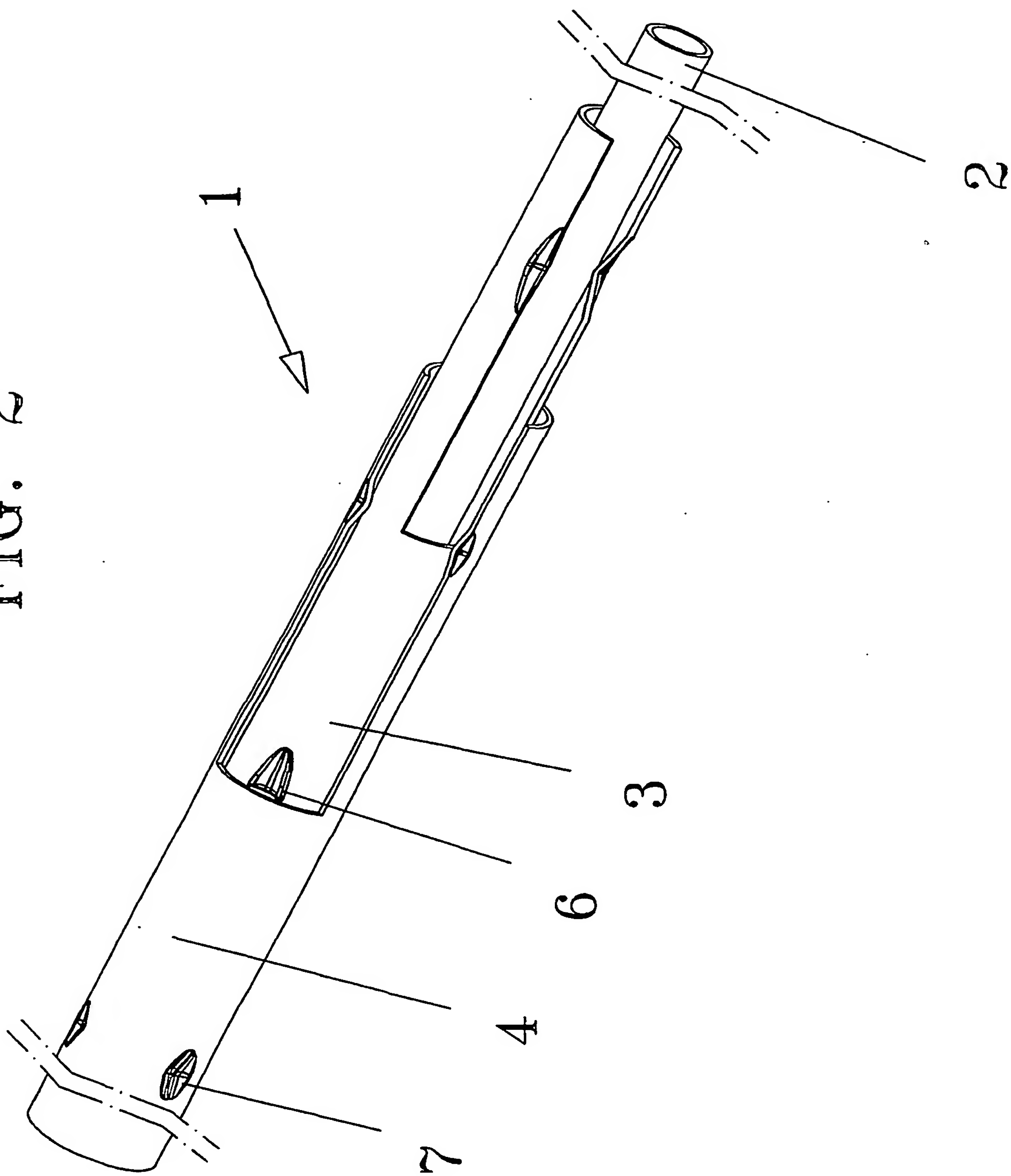


FIG. 2

FIG. 3

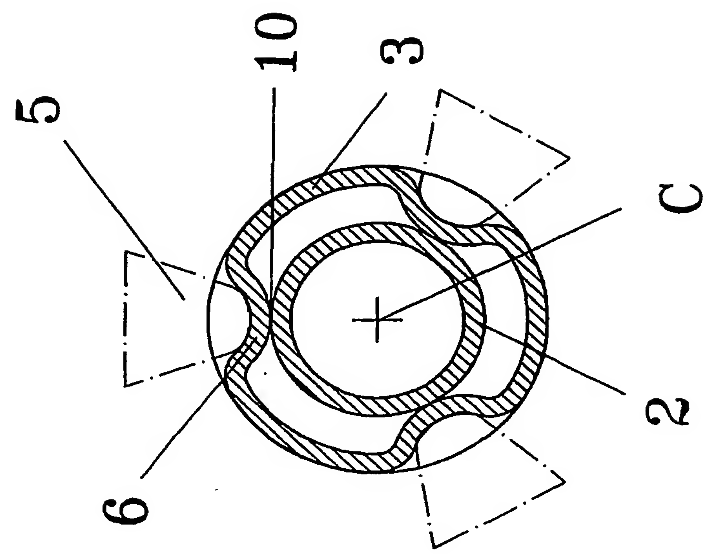
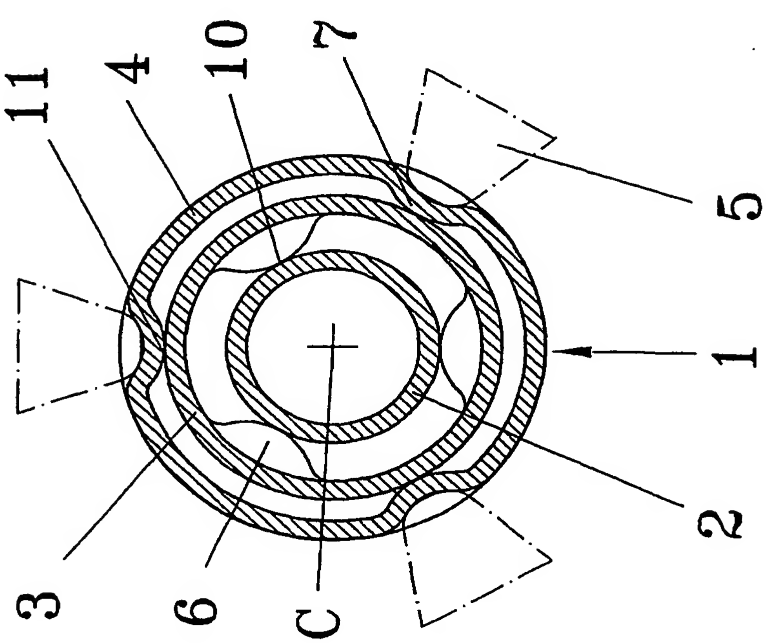


FIG. 4



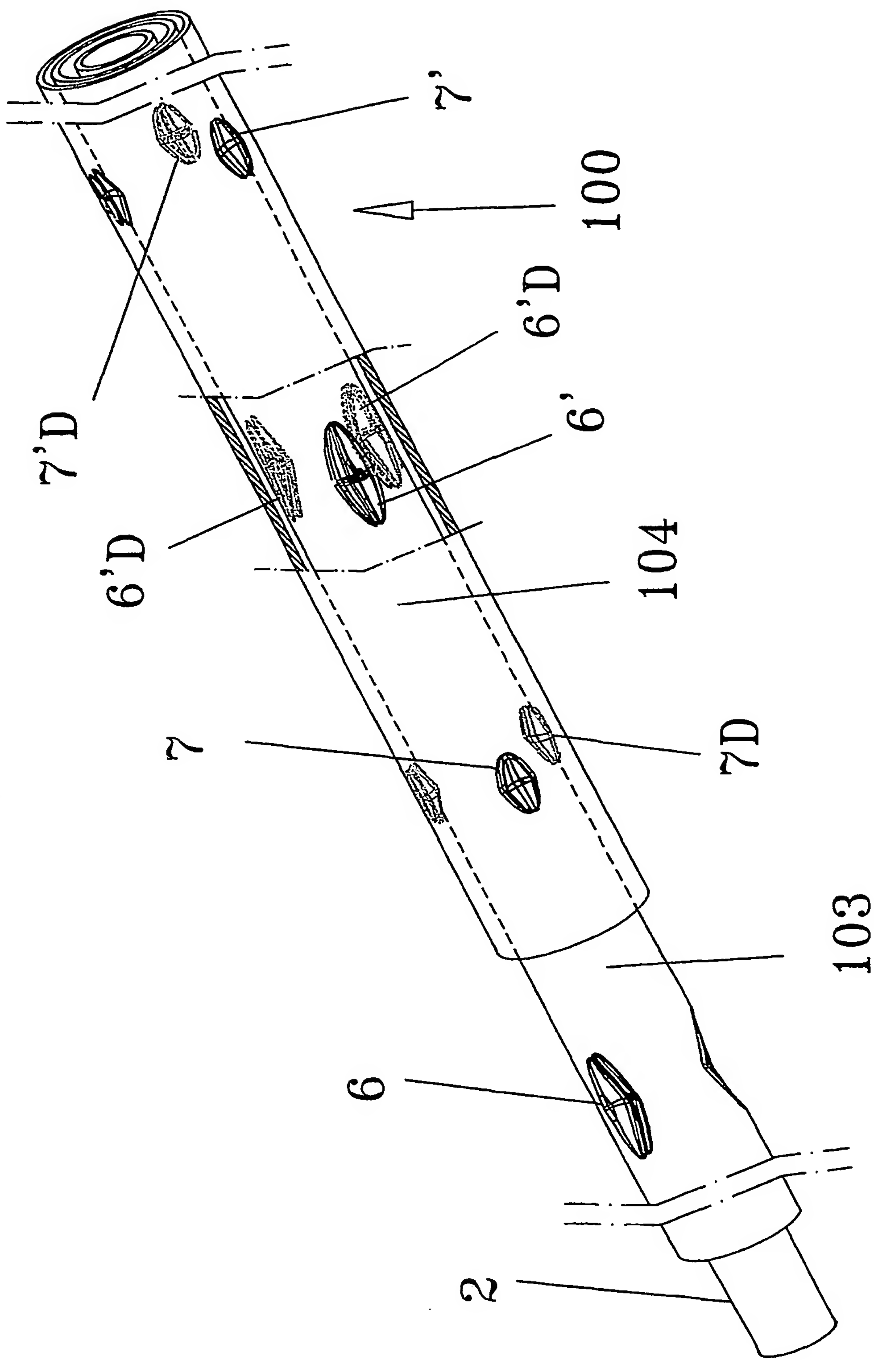


FIG. 5

FIG. 6

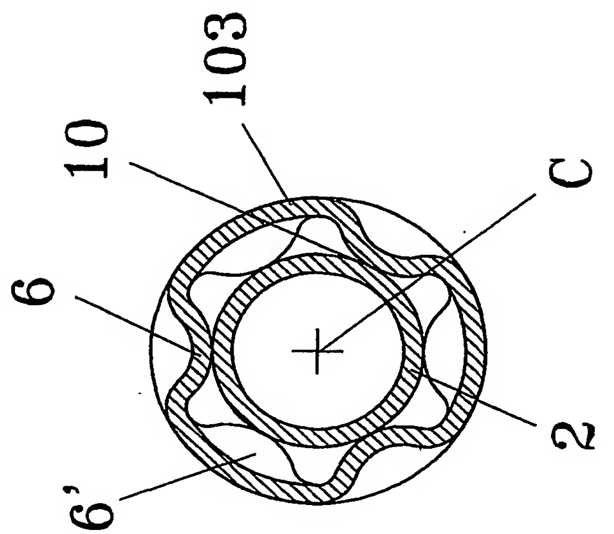


FIG. 7

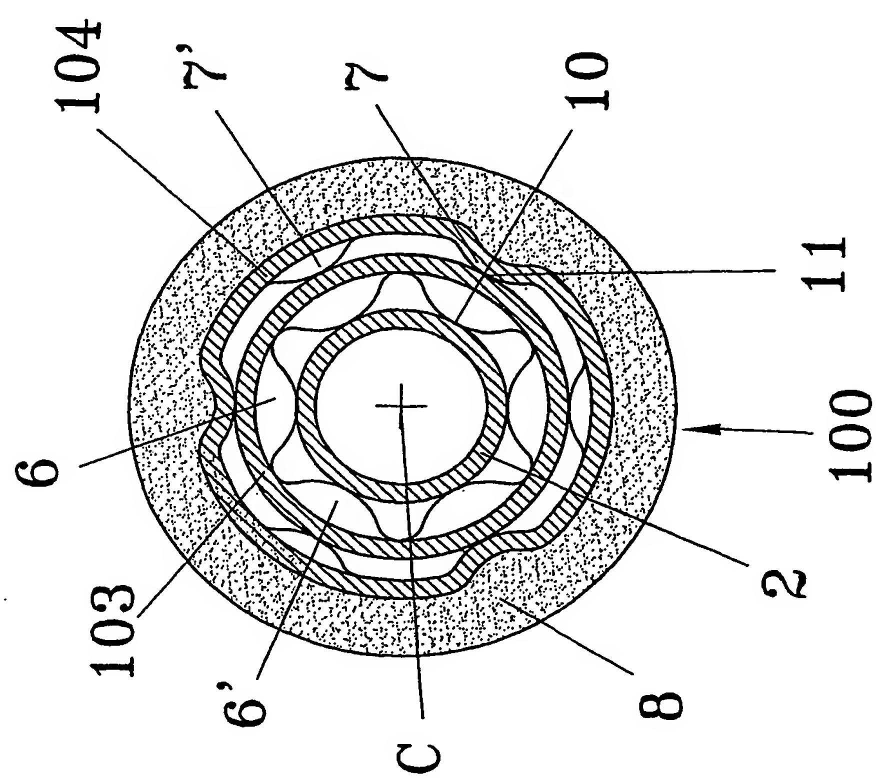


FIG. 8

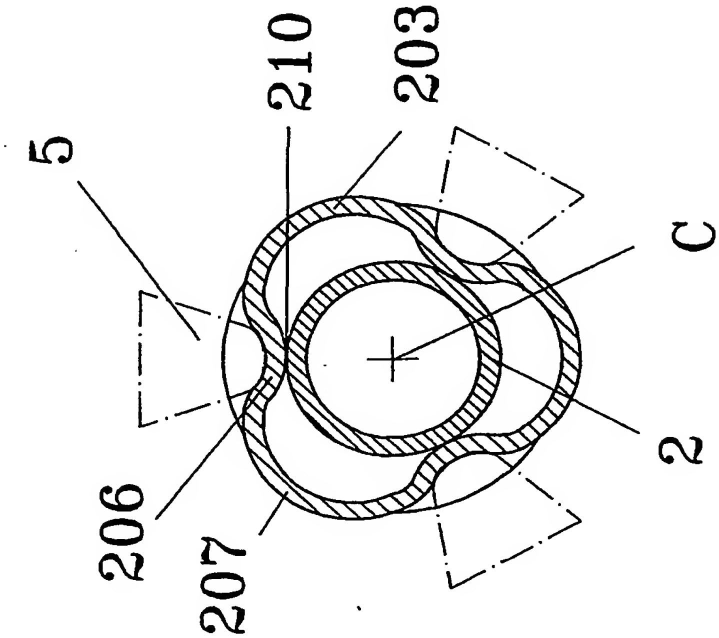
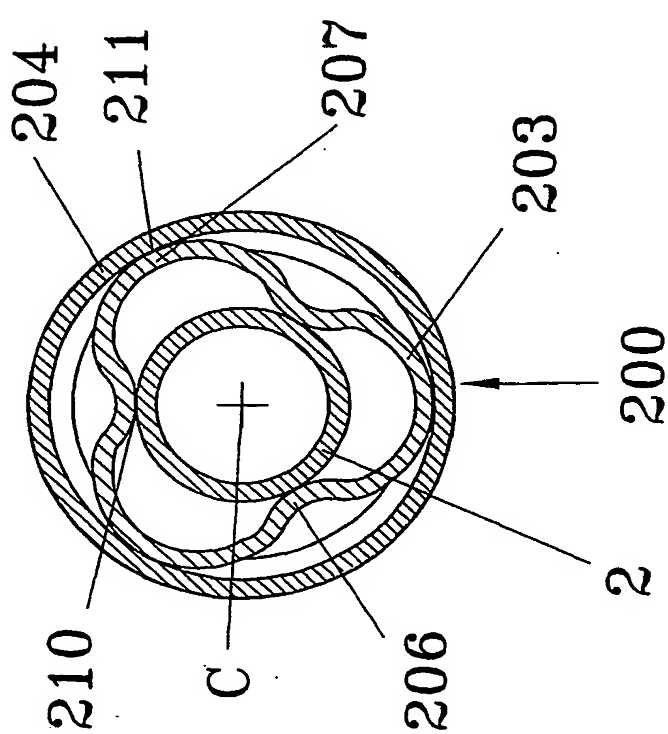


FIG. 9



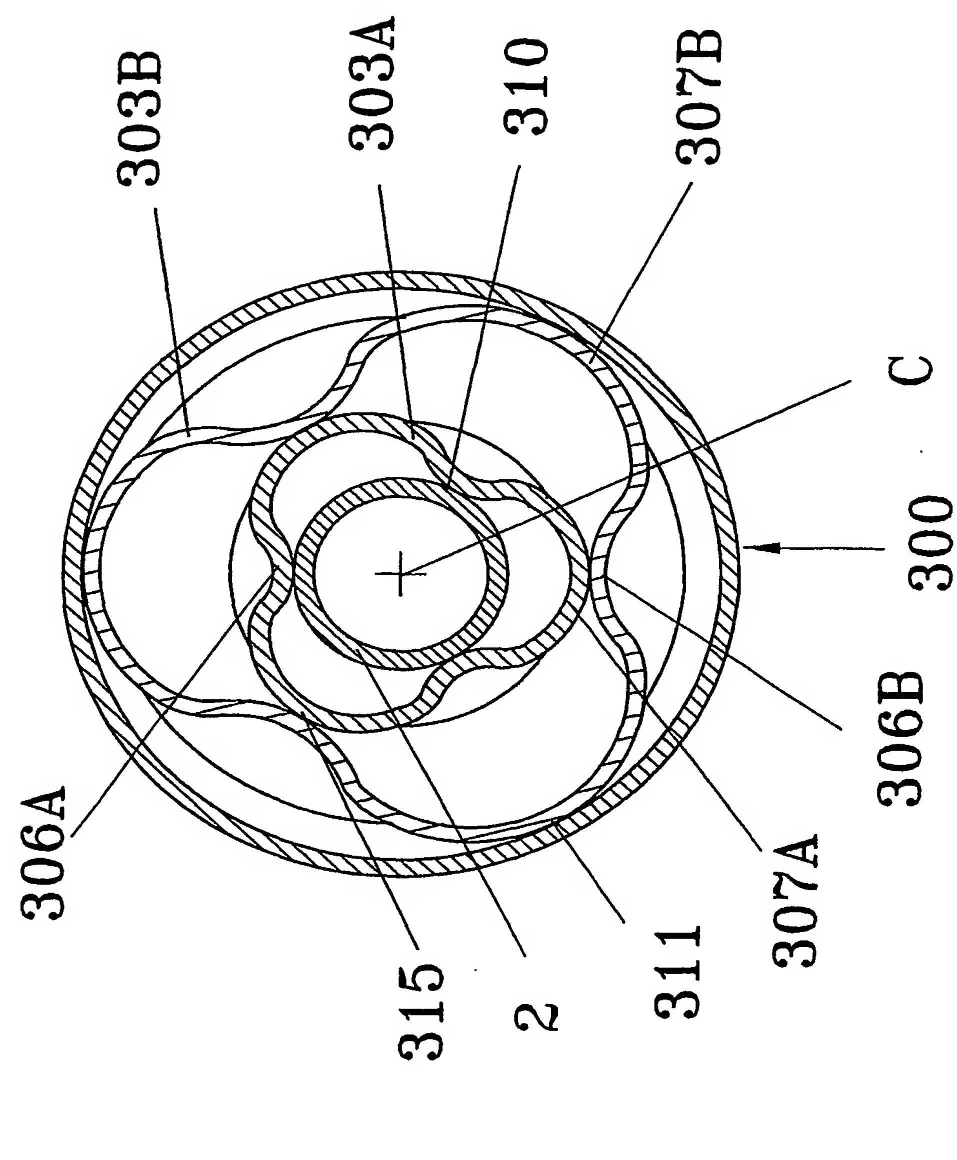


FIG. 10

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 01/01467

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: C21C 5/46, F27D 3/16, F27D 3/18

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: C21C, F27D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO INTERNAL, WPI DATA, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	JP 7228911 A (KAWASAKI STEEL CORP) 1995-08-29 (abstract) World Patents Index (online). London, U.K.: Derwent Publications, Ltd. (retrieved on 2001-10-01). Retrieved from: EPO WPI Database. DW199543; Accession No: 1995-332785 & JP 7-228911 A (KAWASAKI STEEL CORP), 1995-08-29 --	1-35
A	US 3889933 A (LOUIS HAROLD JAQUAY), 17 June 1975 (17.06.75) --	1-35

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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Date of the actual completion of the international search	Date of mailing of the international search report
1 October 2001	03 -10- 2001
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Anna-Maj Magnusson/MP Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 01/01467

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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A	DE 3616510 A1 (CLEMENS, KARL-HEINZ), 19 November 1987 (19.11.87) -- --------	1-35

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Information on patent family members

03/09/01

International application No.
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